Limited Visual Dam Safety Inspections

OA00018

Opaeula 01 Reservoir

Oahu, Hawaii

Prepared by:

U.S. ARMY CORPS OF ENGINEERS
HONOLULU DISTRICT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

May 2006

Dam ID: OA-018
Name: Opaeula 01 Reservoir

Limited Visual Dam Safety Inspection Conducted on: 04 April 2006

I. Purpose:

Due to disaster occurrences of periodic heavy rains and flooding, which has caused extensive damage to property and loss of lives, the Governor has issued a State of Emergency Proclamation extending from February 20, 2006 to April 9, 2006. In light of the tragic failure of the Kaloko dam on Kauai and the continued forecast of heavy rains, emergency inspections of all regulated dams in all counties are being undertaken.

These inspections are for the purpose of determining if any of the regulated dams and reservoirs in the City and County of Honolulu, Maui County or Hawaii County, are suspect for immediate concern to the downstream area under the prolonged conditions of heavy rain showers.

II. Authority

Inspections were authorized under the Hawaii Dam Safety Act of 1987, Chapter 179D "Dams and Reservoirs" of Hawaii Revised Statues, and Title 13, Subtitle 7, Chapter 190, "Dams and Reservoirs" of the Hawaii Administrative Rules.

These inspections were conducted under joint agreements of the U.S. Army Corps of Engineers (ACE), the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), and the State of Hawaii. The Memorandum of Agreement with the U.S. Army Corps of Engineers is entered into pursuant to 10 U.S.C. § 3036(d)(2), and the Intergovernmental Cooperation Act (31 U.S.C. §6505), and established via support agreement number DL-06-01.

III. Scope

Visual inspection was performed on parts of the embankment and appurtenant works readily available and visible for inspection by the inspection team at the time of the inspection. Such parts and appurtenant works included the upstream slope, crest, downstream slope, abutments and toes, outlet works, and spillway.

On the date of this limited visual inspection, there may or may not have appeared to be any immediate threat to the safety of the dam, however no assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

IV. Limitations of Findings and Recommendations

The inspection is based only on visible features/areas of the dam on the day of inspection. The inspection does not entail detailed stability, hydrologic, hydraulic, or seismic investigations. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies.

Dam ID: OA-018
Name: Opaeula 01 Reservoir

V. Inspection Team

Organization	Name
U.S. Army Corps of Engineers	Mr. Troy Cosgrove
State of Hawaii, Dept. of Land and Natural Resources	Mr. Carty Chang
National Resource Conservation Service	Mr. Sherman White

VI. Owner's Representatives Present

Mr. Kaeo Duarte, Kamehameha Schools
Ms. Kapu Smith, Kamehameha Schools
Mr. Jim Lodl, Kamehameha Schools

VII. Summary Report Team

Organization	Name
U.S. Army Corps of Engineers	Mr. Derek Chow
	Mr. Joseph Koester
State of Hawaii, Dept. of Land and Natural Resources	Ms. Denise Manuel
	Mr. Edwin Matsuda

VIII. Dam Type

The dam is an earthen embankment.

IX. Dam Classification

The current hazard classification of this dam is: High

Based on available data, this classification is believed to still be applicable.

Hazard Potential Classification based on the following:

Category	Loss of Life	Economic Loss
Low	None Expected	Minimal (undeveloped to occasional structures or agriculture)
Significant	Few (No Urban development and no more than a small number of inhabitable structures)	Appreciable (Notable agriculture, industry or structures)
High	More than a few	Extensive community, industry or agriculture.

Based on inventoried storage and height data, the size classification of the dam is: Small

Size Classification based on the following:

Category	Storage (Acre-Feet)	Height (feet)
Small	< 1000	< 40
Intermediate	> 1000 and < 50,000	> 40 and < 100
Large	> 50,000	> 100

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X. Summary of Inspection:

Condition Rating Criteria: The conditional terms in this report are used to generally describe the conditions below. Inspections, monitoring, and additional investigations are considered to be incidental to all condition ratings.

Satisfactory	Expected to fulfill intended function.
Fair	Expected to fulfill intended function, but maintenance is recommended.
Poor	May not fulfill intended function; maintenance or repairs are necessary.
Unsatisfactory	Is not expected to fulfill intended function; repair, replacement, or modification is necessary.
Unknown	Not visible, not accessible, not inspected, or unable to determine the condition rating based on the observation taken.

A. General appearance:

The reservoir and dam features were easily recognizable.

Modifications / Improvements: There were no signs of any recent modifications.
Based on topography, limited offsite drainage is expected.
The reservoir appeared to have a small surface drainage area.
Based on staff personnel, this reservoir has no incident history.

Findings and Corrective Actions:

a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
b. An EAP is required for High Hazard Dams. Submit an updated EAP for this facility.
c. Routine inspection logs were not inspected.
d. Dam owners shall provide for routine inspection of the dam.
e. Access to site appears to be satisfactory.
f. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
g. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
h. Submit copies of additional studies conducted (Phase II inspection).
i. Emergency Alarms / Monitors: There were no alarms or monitors observed on this reservoir.
j. Power / Communication: There were no communication systems observed on this reservoir. There were no utility or power poles visible nearby.

B. Access / Security:

Access to the dam was accomplished via a private roadway.
Access requires a 4 wheel drive vehicle.

Valves are locked. Access to the dam is via locked gates.

C. Inflow Works:

The inflow works were not observed. However, according to staff personnel, there are about 5 inlets feeding the reservoir. These are via a Culvert/pipe/ditch and/or flume

The intake or inlets have the ability to be shut off or diverted away from the reservoir during periods of heavy rains. This is done manually.

Findings and Corrective Actions:

a. The intake works were not inspected.
b. The intake works were not tested.

D. Reservoir

The reservoir level during the inspection was 55 ft per the staff gage.
A staff gage was observed near the left side of the reservoir.
According to staff personnel, the reservoir is normally operated at +/- 40 ft per gage.
Typically the spillway is not flowing.

Findings and Corrective Actions:

a. The reservoir was not inspected.

E. Upstream Slope (Fair)

The upstream slope was roughly 1V to 2H (Vertical / Horizontal)
A dumped rock slope protection was observed. Little vegetation was observed growing between the rocks.
Erosion was observed on right side of dam near abutment.
Cracks were not observed.
Sinkholes were not observed.
The upstream slope was visible.

Findings and Corrective Actions:

a. The upstream slope appeared to be in fair to poor condition and requires corrective action.
b. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: Fill and compact gully.
c. Tree(s) were observed on the dam embankment. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2” diameter and

reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer.

d. Maintain vegetation so embankment is visible.

F. Crest: (Fair)

The dam crest was approximately 15 feet wide.
There was a dirt access road on top of the crest that appeared to be well utilized.
There was little vegetation on either edge of the crest, which consisted of some low ground cover and high grass.
An erosion gully was observed at the entrance to the crest on the left site of the dam. This could be problematic if not corrected.
Cracks were not observed.
Sinkholes were not observed.

Findings and Corrective Actions:

a. The dam crest appeared to be in fair to poor condition and requires corrective action.
b. Access along the crest was satisfactory.
c. Rut and/or Gully erosion was observed on the crest, which requires maintenance and/or repair. Description: Fill and compact gully. Grade surrounding area to drain without erosion.

G. Downstream Slope: (Fair)

The downstream slope was in fair condition with some high grass and a few trees.
The slope was very steep, around a 1V to 1H slope.
There was access to the downstream slope via a walking path.
There was no slope protection observed on the downstream slope.
Erosion was observed on the downstream walking path and no erosion was observed on the downstream slope.
Sinkholes were not observed on the downstream slope, however the slope was not entirely visible.
Vegetation was observed on the downstream slope. The majority of the vegetation was high grass with a few woody trees less than 6” in diameter.
Seepage was not observed on the downstream toe, however the slope was not entirely visible.

Findings and Corrective Actions:

a. The downstream slope appeared to be in fair to poor condition and requires corrective action.
b. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: Repair gully on access path by filling, compacting, and regrading. If not corrected could be problematic.
c. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
d. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is

required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

e. The slope was very steep, around a 1 to 1 slope, further study is required to verify slope stability.

H. Abutments / Toe: (Fair)

The abutments and toe appeared to be in good condition with some vegetation and tress near the toe.
Erosion along the abutment or toe was not observed.
Cracks in either direction were not observed, however the abutments and toe were not entirely visible.

Findings and Corrective Actions:

a. The abutments/toe appeared to be in fair to poor condition and requires corrective action.
b. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
c. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause severe damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

I. Outlet Works: (Fair)

Not inspected in detail, not tested.
Water was above the upstream gate works.
The outlet works appeared to be two 18" pipes made of ductile iron. Only one of the pipe was operational.
The outlet works was controlled via a valve on the downstream side of the dam.
Seepage was not observed flowing near the exit of the outlet works from the dam.

Findings and Corrective Actions:

a. The outlet works were not tested.
b. The outlet works appeared to be in fair to poor condition and requires corrective action.
c. Suggest repairing unused valve and pipe to have a back-up if main fails. Back-up may also be needed in emergency situation.

J. Spillway: (Fair)

This spillway consisted of a tunnel in rock with a concrete entrance near the left abutment. The outlet of the spillway was not observed.
The rough dimensions were 10 ft high by 7 ft wide by approximately 100 ft long.
The spillway channel plunges into a pool, which feeds a drainage swale that runs along the base of the downstream toe and then heads downstream.

The spillway approach was mostly clear with the exception of a area of trees and vegetation to the left of the entrance. This vegetation and trees should be cleared back from the entrance to prevent debris from entering the spillway tunnel.
There was erosion observed near the spillway were it plunges into a pool. It is approximately a 50 ft plunge into the pool.
Further investigations should be conducted to conclude the capacity of the spillway.

Findings and Corrective Actions:

a. The Spillway appeared to be in fair to poor condition and requires corrective action.
b. A headcut was observed downstream of the spillway. Corrective / mitigative action is required to prevent this problem from moving upstream.
c. Trees are unacceptable in the spillway channel and approach. Take corrective action to address the woody vegetation problem and repair the damaged area.
d. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.
e. Monitor spillway plunge pool to ensure erosion does not damage spillway exit.

K. Down Stream Channel: (Unknown)

The down stream channel was not investigated.
If the dam were to fail, the resulting flood wave would probably enter a tributary to the Anahulu River.
There is a well-defined downstream channel.

Findings and Corrective Actions:

a. The downstream channel was not inspected.

XI. Additional Comments:

Original field inspection notes were scanned and are attached to this summary report. Included are several photos from the site visit to detail important features of the project, captioned to be self-explanatory. A Phase II was performed in 1998. Access to the spillway exit needs to be improved to inspect. Currently the exit is difficult to inspect because of the plunge pool.

Per e-mail dated 5/2/2006, 5:16 a.m. from Troy Cosgrove, USACE
Intake Works:
Please indicate if the intake was a culvert/pipe or a ditch/flume. Type if intake unknown was not inspected. In the field it was stated that there is a series of ditches and tunnels that feed the reservoir.

Please describe the intake works to include, size, control and from. Size and control unknown not inspected. From stream diversion, as stated in field.

If it is a ditch/flume also indicate the dimension and shape. Dimension and shape unknown, not inspected.

Upstream slope:
Please indicate if sinkholes were observed. None observed.

Comments:
Please indicate if the dam presented a safety hazard at the time of inspection. The dam did not present a safety hazard at the time of inspection.

Also please comment to the owner about the erosion at the entrance to crest. Should it be corrected immediately (within 6 months)? It is recommended that the erosion at the crest be repaired within 6 months.

Would it be in their best interest to have a structural or geotechnical engineer assist them with the corrective action? Yes

Would the same apply for the spillway? The same would apply to the spillway.

Please provide comments about the vegetation blocking spillway entrance. There is a stand of tress near the spillway entrance that could be problematic during high flows. The trees do not block the entrance.

PHOTOGRAPHS

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Photo 1 Spillway tunnel.

Photo 2 Spillway tunnel entrance.

Photo 3 Staff gage.

Photo 4 Upstream slope.

Photo 5 Downstream access road erosion.

Photo 6 Downstream slope.

Photo 7 Spillway plunge pool.

Photo 8 Outlet pipes.

Photo 9 Outlet channel.

Photo 10 Access pit at top of dam.

Photo 11 Spillway entrance, trees need to cleared.

Photo 12 Dam crest, erosion gully on access road.

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Photo 13 Reservoir overview.

FIELD INSPECTION SHEETS

Dam ID: OA-0018
OPAEULA 01 RESERVOIR

Vulnerability Index:
Extreme 1 | High 2 | Moderate 3 | Low 4

Inspection No:
Date: 4/4/06

STATE OF HAWAII - DLNR
DAM SAFETY INSPECTION SHEET

Inspection Type: Visual Dam Safety Inspection

Persons Present	Affiliation	Phone Number
Troy Cosgrove	US Army Corps of Engineers	
Carty Chang	DLNR	
Sherman White	NRCS	
Kaeo Duart	Kamehameha Schools	
Kapu Smith	Kamehameha Schools	
Jim Lodl	Kamehameha Schools	

Weather Condition: ☐ Rain previous day ☐ Rainy ☐ Drizzle / Mist ☐ Cloudy/Overcast ☑ Partly Cloudy ☐ Sunny ☐ Dry

Comments:

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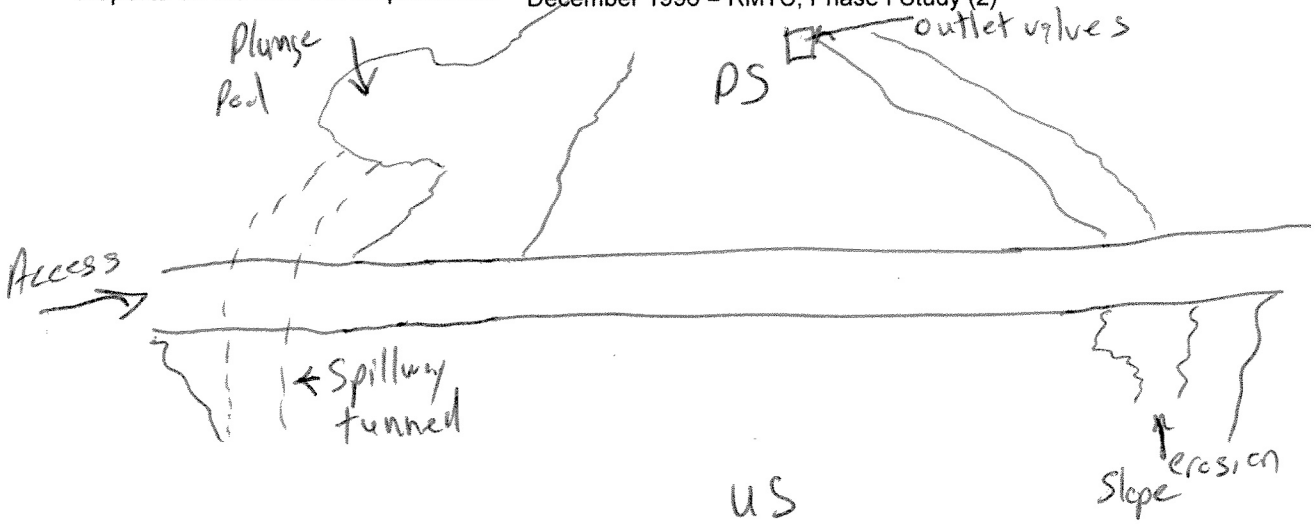
1. General: *(Information currently on file, update as required)*

Dam/Res. Name	OPAEULA 01 RESERVOIR		
Owner	Kamehameha Schools		*(C002)*
Owner Contact	Mr. Kaeo Duarte	Owner Ph.	
Lessee		Lessee Ph.	
O & M Contractor		O & M Ph.	
Nearest Town	HALEIWA	Latitude	21.5733° (decimal)
County	HONOLULU	Longitude	158.03° (decimal)
Tax Map Key(s)	(1)6-2-011:001		

Dam Status	A:	Hazard Potential	H:	Dam Size	
Year Completed	1910	Dam Length	250 ft.	Dam Height	20 ft.
Normal Storage	258 ac.ft.	Max. Storage	400 ac.ft.	Max. Surface Area	0 ac.
Drainage Area	0 mi.	Spillway Type		Max. Spillway Q	0 cfs

Owner owns land under dam facility:
Emergency Action Plan on file with the Department: NO
Reports on file with the Department: December 1996 = RMTC, Phase I Study (2)



US

NTS

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2. Questions for Owner's Rep.:

	Yes	No	Unknown	Comments
Construction Plans Available	☑	☐	☐	
Site / Facility Map	☑	☐	☐	
Operation & Maintenance Manual	☐	☑	☐	
Emergency Action Plan	☐	☑	☐	Contact Plan in place @ KK schools
Modifications / Improvements	☐	☑	☐	
Conduct Routine Inspections	☑	☐	☐	
Conduct Routine Maintenance	☑	☐	☐	
Vehicle access to site	☑	☐	☐	☐ Not accessible ☐ With Standard car ☑ Requires 4-Wheel Drive
Access during heavy rains	☑	☐	☐	☐ Not accessible ☐ With Standard car ☑ Requires 4-Wheel Drive
Access when spillway is flowing	☑	☐	☐	☐ Not accessible ☐ With Standard car ☑ Requires 4-Wheel Drive
Other Studies Conducted	☑	☐	☐	☑ Phase I ☑ Phase II ☐ Hydraulics ☐ Stability ☐ Hazard ☐ Seismic ☐ Other: _____
Incident History	☐	☑	☐	☐ Breached ☐ Overtop ☐ Slide ☐ Down stream Flooding ☐ Other: _____
Reservoir's Current Use	☑	☐	☐	☐ Sediment ☑ Irrigation ☐ Recreation ☐ Flood Control ☐ Drinking Water ☐ Power Generation ☐ Other: _____

Findings and Corrective Actions:

- ☑ a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- ☐ b. An Emergency Action Plan (EAP) is on file with the department, submit any updates as applicable.
- ☑ c. An EAP is required for High Hazard Dams. Submit an updated EAP for this facility. 4/25/06 EAP (received)
- ☐ d. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
- ☐ e. Submit narrative and additional information detailing the improvements, modifications, and/or alterations at the dam site, unless covered by approved dam permit.
- ☑ f. Routine inspection logs were not inspected.
- ☑ g. Dam owners shall provide for routine inspection of the dam.
- ☐ h. The dam did not appear to be maintained on a regular basis.
- ☑ i. Access to site appears to be satisfactory.
- ☐ j. There is no vehicular access to the dam site. Operational and emergency plans need to reflect this deficiency or access provided.
- ☐ k. Access to dam is questionable during severe weather conditions and/or spillway overflows. Operational plans and emergency plans need to reflect this deficiency or access provided.
- ☐ l. Provide a detailed narrative of the incident, responses taken, and any damages incurred. Dam owners are required to promptly advise the department of any sudden or unprecedented flood or unusual or alarming circumstance or occurrences which may adversely affect the dam or reservoir.
- ☑ m. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
- ☑ n. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- ☑ o. SUBMIT COPIES OF ADDITIONAL STUDIES CONDUCTED (PHASE II INSPECTION) 4/25/06 COPY (received)

Additional Requirements:

The following investigative study(s) are:

Required	Recommended	
☐	☐	Phase I Study
☐	☐	Phase II Study (Including ☐ Seepage ☐ Hydrology/Hydraulics ☐ EAP)
☐	☐	Hydrology and Hydraulics (including Probable Maximum Flood and spillway capacity)
☐	☐	Stability Analysis
☐	☐	Seismic Analysis
☐	☐	Hazard Classification
☐	☐	Other: _____

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OPAEULA 01 RESERVOIR

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Physical Dam Features: (Check All Applicable. Provide description of Items Observed and/or Take Photos. Indicate photo # in description.)

3. Reservoir:

Level during inspection 55 ft per gage (gage / other)

Normal Operating Level/Range 40± ft per gage (gage / other)

Description: Keep within normal range by inflow and outlet control. more wide due to increase precipitation.

Typical Operation ☐ Spillway always flowing ☑ Kept within normal range ☐ Kept Empty ☐ Drained Daily ☐ Only filled by Storms

☐ Other: _____

Sinkhole in Res.: ☐ # Observed: _____ Size: _____ by _____ in. Deep ☑ Not Visible ☑ None Observed

Description: _____

Staff Gage: Description: ~~Board~~ TTC Board with painted numbers.

Findings:

☑ a. The reservoir was not inspected.
☐ b. The reservoir appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ c. The reservoir appeared to be in fair to poor condition and requires corrective action.
☐ d. The reservoir appeared to be in unsatisfactory condition, urgent corrective action is required.

Corrective Actions:

☐ e. The staff gage needs maintenance and/or repair. Description: _____
☐ f. A staff gage was not observed at the reservoir. Provide some method of quantifying the water level within the reservoir.
☐ g. A sinkhole was observed in the upstream reservoir. Conduct additional investigations and monitoring to identify the cause, risk and appropriate action.
☐ h. _____

4. Intake Works Description:

☑ Number of Intakes 25

☐ Intake Culvert / Pipe
Size: _____ in. ☐ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other _____
Control: ☐ Gate ☐ Valve ☐ Flow can either be Shut off or Bypassed
From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other _____

☐ Ditch / Flume
Dimension: _____ (Size x Depth) Shape _____
Surface: ☐ Dirt ☐ Wood ☐ Concrete ☐ Lined w/ _____
Control: ☐ Gate ☐ Valve ☐ Flow can either be Shut off or Bypassed
From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other _____

Findings:

☑ a. The intake works were not inspected.
☑ b. The intake works were not tested.
☐ c. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ d. The intake works appeared to be in fair to poor condition and requires corrective action.
☐ e. The intake works appeared to be in unsatisfactory condition, urgent corrective action is required.

Corrective Actions:

☐ f. The intake works needs maintenance and/or repair. Description: _____
☐ g. _____

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5. Upstream Slope: (Typical Slope ± 1V : 2H)

Slope Protection: ☐ None ☑ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☐ Liner ____ ☐ Other: ____

☐ Defect in Protection: Description: ____

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☑ Gully (>6" deep) ☐ Not Visible ☐ None Observed

Description: Erosion right side near abutment. Entire slope above water line

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☑ None Observed

Description: ____

Sinkholes: ☐ # Observed: ____ Size: ____ and ____ Depth ☐ Not Visible ☐ None Observed

Description: ____

Vegetation: ☐ None ☑ Low Ground Cover ☑ Bushes or Tall Grass ☑ Trees # few ☑ <6" ☐ >6" & <20" ☐ >20"

Description: Some low cover and tall grass, but pretty well maintained. Can see most of US face

Findings:

☐ a. The upstream slope was not inspected.

☐ b. The upstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.

☑ c. The upstream slope appeared to be in fair to poor condition and requires corrective action.

☐ d. The upstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ e. Slope protection needs maintenance or repair. Description: ____

☑ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: Fill and compact gully.

☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.

☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.

☐ i. The upstream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.

9/23/06 revised by El. Matsuo

☑ j. Tree(s) were observed on the dam embankment. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.

☑ k. Maintain vegetation so embankment is visible.

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Inspection No: _____
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6. Crest: Approximate Crest Width: ≥ 15ft

Access: ☐ None ☐ Walking Path ☑ Roadway, Surface / Width / Usage: Dirt

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☑ Gully (>6" deep) ☐ Not Visible ☐ None Observed
Description: Some erosion at entrance to crest. Could be problematic if

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☑ None Observed not correct
Description: _____

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☐ Not Visible ☑ None Observed
Description: _____

Vegetation: ☐ None ☑ Low Ground Cover ☑ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"
Description: Some tall grass, but crest was visible.

Findings:

- ☐ a. The dam crest was not inspected.
- ☐ b. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☑ c. The dam crest appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The dam crest appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

- ☐ e. Access along the crest was satisfactory.
- ☐ f. Access along the crest was not possible. Description: _____
- ☑ g. Rut and/or Gully erosion was observed on the crest, which requires maintenance and/or repair. Description: Fill and compact gully and grade to drain without erosion.
- ☐ h. A crack was observed on the crest, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ i. A sinkhole was observed on the crest, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ j. Portions of the crest were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ k. Tree(s) were observed along the dam crest. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ l. _____

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7. Downstream Slope:

(Typical Slope ± 1V : 1H)

Access: ☐ lower roadway along toe ☑ roadway to outlet works ☐ walkway to outlet works ☐ None Observed

Slope Protection: ☑ None ☐ Dumped Rock ☐ Rip Rap ☐ Grouted Rip Rap ☐ Concrete

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☑ Gully (>6" deep) ☑ Not Visible ☐ None Observed
Description: High grasses, rut/gully on DS access path

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☑ Not Visible ☐ None Observed
Description: High grasses

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☑ Not Visible ☑ None Observed
Description: High grasses

Vegetation: ☐ None ☐ Low Ground Cover ☑ Bushes or Tall Grass ☑ Trees # few ☐ <6" ☐ >6" & <20" ☐ >20"
Description: ~~Some~~ few small trees and tall grass

Seepage:

Seep Spot Number 1
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☑ Not Visible ☐ None Observed
☐ Flowing, Description: high grass
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
Description: _____

Seep Spot Number 2
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☑ Not Visible ☐ None Observed
☐ Flowing, Description: high grass
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
Description: _____

Findings:

☐ a. The downstream slope was not inspected.
☐ b. The downstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
☑ c. The downstream slope appeared to be in fair to poor condition and requires corrective action.
☐ d. The downstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ e. Slope protection needs maintenance or repair. Description: _____
☑ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: Gully was observed on access path may be problematic needs repair.
☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
☑ i. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
☑ g. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
☐ h. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
☐ i. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
☑ j. The slope was very steep, around a 1 to 1 slope, further study is required to verify slope stability.
☐ k. _____

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8. Abutments/Toe:

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☑ None Observed
Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☑ None Observed
Description: _____

Vegetation: ☐ None ☐ Low Ground Cover ☑ Bushes or Tall Grass ☑ Trees # Some ☑ <6" ☑ >6" & <20" ☐ >20"
Description: Some vegetation and trees near toe

Seepage:
Seep Spot Number 1
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☑ Not Visible ☑ None Observed
☐ Flowing, Description: _____
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
Description: _____

Seep Spot Number 2
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed
☐ Flowing, Description: _____
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
Description: _____

Findings:

☐ a. The abutments/toe were not inspected.
☐ b. The abutments/toe appeared to be in satisfactory condition, no corrective actions are required at this time.
☑ c. The abutments/toe appeared to be in fair to poor condition and requires corrective action.
☐ d. The abutments/toe appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ e. Slope protection needs maintenance or repair. Description: _____
☐ f. Rut and/or Gully erosion was observed, which requires maintenance and/or repair. Description: _____
☐ g. A crack was observed along the abutments/near the toe, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
☑ h. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
☑ i. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
☐ j. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
☐ k. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
☐ l. _____

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9. Outlet Works:

Culvert / Pipe

Type / Size: 2 x 18" pipes, left side always used, inlets in lake not visible

Culvert: ☐ Concrete ☐ Masonry ☐ unlined earth ☐ Other _____

Pipe: ☑ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other _____

Control Type: ☐ Gate ☑ Valve ☐ Other _____

Location: ☐ Control on Upstream side ☑ Control on Downstream side

Seepage: ☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☑ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

Findings:

☐ a. The outlet works were not inspected.

☑ b. The outlet works were not tested.

☐ c. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.

☑ d. The outlet works appeared to be in fair to poor condition and requires corrective action.

☐ e. The outlet works appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ f. Seepage/Ponding water was observed. Conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.

☐ g. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area. Failures caused by seepage/piping along the outlet conduit are very common and are considered to be a dangerous situation.

☐ h. Were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.

☑ i. Repair unused valve and pipe, if main fails could be problematic back up could be needed in emergency situation.

☐ j. _____

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10. Spillway:

Type: ☐ None ☑ Culvert/Pipe ☐ Channel rock
Description: Tunnel in pipe with concrete entrance, outlet not observed
Dimension: ≈10' x 7' ft. Invert elevation: unknown ft. per staff gage ≈ 651
Slope Protection: ☑ None ☐ Grass ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☐ Concrete
☐ Defect in Protection: Description: _____
Approach: ☐ Clear ~~☐ High Veg.~~ ☑ Trees ☐ Other: _____
Erosion: ☑ Scour ☐ Gully ☐ Headcut ☐ Not Observed ☑ Other: Plunge pool
Description: Spillway plunges into pool. ≈ 50ft drop may cause erosion in spillway tunnel
Vegetation: ☐ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☑ Trees # Some ☑ <6" ☑ >6" & <20" ☐ >20"
Description: Clear trees back from spillway entrance to prevent blockage

Findings:

☐ a. The Spillway appeared to be in satisfactory condition, no corrective actions are required at this time.
☑ b. The Spillway appeared to be in fair to poor condition and requires corrective action.
☐ c. The Spillway appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ d. Slope protection needs maintenance or repair. Description: _____
☐ e. The spillway approach was blocked. Clear approach.
☐ f. Severe scour erosion was observed which requires maintenance and/or repair.
Description: _____
☑ g. A headcut (vertical drop in channel due to erosion) was observed downstream of the spillway. Corrective action is required to prevent this problem from moving upstream.
☑ h. Trees are unacceptable in the spillway channel and approach. Take corrective action to address the woody vegetation problem and repair the damaged area.
☑ i. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.
☑ j. Monitor spillway plunge pool for ensure erosion does not ~~cause~~ ing damage spillway exit

11. Down Stream Channel:

Name: Tributary to Anahulu River
Downstream: ☐ Sump ☐ Open Area ☐ Un-Defined Drainage-way ☑ Defined Drainage-way ☐ Other _____
Items along Stream Bank: ☑ None ☐ Road ☐ Houses ☐ Town ☑ Not Inspected
Description: _____

Findings:

☑ a. The downstream channel was not inspected.
☐ b. The downstream channel appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ c. The downstream channel appeared to be in fair to poor condition and requires corrective action.
☐ d. The downstream channel appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

Corrective Actions:

☐ e. _____

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Additional Comments:

On the date of this limited visual inspection, there appeared to be no immediate threat to the safety of the dam. No assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

Phase II performed in 1998.
Need to improve access to spillway exit to inspect. Difficult to inspect because of plunge pool.

Limitations and Intent of this Dam Safety Inspection:

This Dam Safety Inspection was conducted to assess the general overall condition of the reservoir/dam, identify visible deficiencies, and recommend areas of for monitoring, additional investigative studies and corrective actions. The inspection is based only on visible features/areas of the dam on the day of inspection. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies. The inspection was conducted under the authority of the Hawaii Revised Statures Chapter 179D, and Hawaii Administrative Rules, Title 13, Chapter 190, titled "Dams and Reservoirs". Questions regarding this inspection should be forwarded to the Hawaii State Dam Safety Program; PO Box 373; Honolulu, Hawaii 96809; Ph. (808) 587-0236.

Revised: Dec. 1, 2003